AN INVESTIGATION OF THE RELATIONSHIP BETWEEN THE INFLATION RATE AND EQUITY PRICE MOVEMENTS AT THE NAIROBI STOCK EXCHANGE

BY

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DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

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DEDICATION

I dedicate this project to my parents Mr. Benson Kiragu and Mrs. Faith Kiragu and to my siblings Emma Kiragu, Judy Kiragu and Rose Kiragu.

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ABSTRACT

The study was carried out to examine if there is a relationship between NSE stock prices and inflation for the period covering 1999 to 2010. The hypothesis tested aimed at showing the relationship between the NSE 20 share index and CPI, inflation and expected inflation.

Secondary data was used in the study and was obtained from different sources including Kenya National Bureaue of Statistics, Central Bank of Kenya, Nairobi Stock Exchange and various publications of the University of Nairobi.

The data was regressed using The Error Correction Mechanism, due to non-stationarity. Results obtained showed that there is indeed a significant relationship between NSE 20 share index and CPI and Nse 20 share index and expected inflation. The Inflation variable used indicated the existence of a relationship but was insignificant.

Based on these results, the study recommends investor education, as there is need to understand the relationship between the stock market and both the CPI movement, the expected inflation and the entire economy. The government needs to ensure that both the monetary and the fiscal policies are carefully applied as they significantly affect both the CPI and the inflation expectations. The NSE should also introduce other alternative investment channels such as options, futures, REITS and commodity trading so that it can be able to compete globally and also offer alternative investment channels for investors not willing to invest in the stocks entirely.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Inflation is the term used to describe a rise of average prices through the economy. It means that money is losing its value. www.wikipedia.org defines inflation as the general level of prices of goods and services in an economy over a period of time. Inflation is an economic concept, is an economy-wide sustained trend of increasing prices from one year to the next. The rate of inflation is important as it represents the rate at which the real value of an investment is eroded and the loss in spending power over time. Inflation also tells investors exactly how much of a return percentage their investments need to make for them to maintain their standard of living. A chief measure of price inflation is the inflation rate, which is the annualized percentage change in a general price index (normally the Consumer Price Index) over time.

There are several variations on inflation: Deflation which is when the general level of prices is falling. This is the opposite of inflation. Hyperinflation is unusually rapid inflation. In extreme cases, this can lead to the breakdown of a nation's monetary system. A good example is Zimbabwe where the inflation rate has exceeded Shilling 1million resulting in the depreciation of the Zimbabwean currency. Stagflation is the combination of high unemployment and economic stagnation with inflation.

The mostly accepted theories of inflation are:

1.1.1 Demand –Pull Inflation

This theory can be summarized as "too much money chasing too few goods". In other words, if demand is growing faster than supply, prices will increase. This usually occurs in growing economies.

1.1.2 Cost-Push Inflation

When companies' costs go up, they need to increase prices to maintain their profit margins. Increased costs can include things such as wages, taxes, or increased costs of

imports. Almost everyone thinks inflation is evil, but it isn't necessarily so. Inflation affects different people in different ways and it also depends on whether inflation is anticipated or unanticipated. If the inflation rate corresponds to what the majority of people are expecting (anticipated inflation), then we can compensate and the cost isn't high. For example, banks can vary their interest rates and workers can negotiate contracts that include automatic wage hikes as the price level goes up.

Problems arise when there is unanticipated inflation as: Creditors lose and debtors gain if the lender does not anticipate inflation correctly. For those who borrow, this is similar to getting an interest-free loan. Uncertainty about what will happen next makes corporations and consumers less likely to spend. This hurts economic output in the long run. People living off a fixed-income, such as retirees, see a decline in their purchasing power and, consequently, their standard of living. The entire economy must absorb reprising costs ("menu costs") as price lists, labels, menus and more have to be updated (Anari,2001).

The easiest way to illustrate inflation is through an example. Suppose you can buy a cake for KES 2 this year and yearly inflation is 10%. Theoretically, 10% inflation means that next year the same cake will cost 10% more, or KES 2.20. So, if your income doesn't increase by at least the same rate of inflation, you will not be able to buy as many cakes. However, a one-time jump in the price level caused by a jump in the price of oil or the introduction of a new tax is not true inflation, unless it causes wages and other costs to increase into a wage-price spiral. Likewise, a rise in the price of only one product is not in itself inflation, but may just be a relative price change reflecting a decrease in supply for that product. Inflation is ultimately about money growth, and it is a reflection of too much money chasing too few products.

With this idea in mind, investors should try to buy investment products with returns that are equal to or greater than inflation. For example, if a stock returned 4% and inflation was 5%, then the real return on investment would be minus 1% (5%-4%).

Stock prices change every day as a result of market forces. By this we mean that share prices change because of supply and demand. If more people want to buy a stock (demand) than sell it (supply), then the price moves up. Conversely, if more people wanted to sell a stock than buy it, there would be greater supply than demand, and the price would fall. The price movement of a stock indicates what investors feel a company is worth. A company's value is therefore different with the stock's price. The value of a company is its market capitalization, which is the stock price multiplied by the number of shares outstanding. For example, a company that trades at KES100 per share and has 1 million shares outstanding has a lesser value than a company that trades at KES 50 that has 5 million shares outstanding (KES100 x 1 million = KES100 million while KES 50 x 5 million = KES 250 million). It's interesting to note that the price of a stock doesn't only reflect a company's current value but it also reflects the growth that investors expect in the future.

Other factors which have been attributed to the price changes include:

1.1.3 Latest information on Stock Prices.

Information is a crucial factor in the movement of stock prices as it is what the market uses to put a value on a stock at a certain price level. These are usually based on all data that the public has been made aware of. As the information is updated, the market adjusts the prices up or down depending on the way the market interprets that the information will affect the company's future earnings ability.

1.1.4 Economic Strength of Market and Peers

Company stocks have the propensity to track with the market, as well as with their sector or industry contemporaries. A lot of leading investment firms put significant importance on overall market and sector movements as major factors involved in the movement of prices. An example would be when a negative outlook for one stock affects other similar ones due to mere association with each other, dragging the demand for the whole sector along the way. This is the case recently experienced in Nigeria due to negative performance of a few banks.

1.1.5 Psychological Issues on Stock Prices

These prices are also greatly influenced by human behavior. Greed is one trait that can cause stock prices to increase more than it should. New information can elicit a frantic market, may cause an increase in prices, and may make investors disregard rational valuation, preferring instead to buy the stock to ensure they are not left behind. Fear can cause significant decreases in stock prices when investors rush for the exit in an effort to avoid losses. Though listed, this factor is probably the most important factor in determining the volatility of the market at any given time.

1.1.6 Supply and Demand

Stocks that trade smaller volumes of shares do not have the liquidity of the more popular stocks. So, prices for these smaller ones are prone to fluctuations because of supply and demand. When a large shareholder wants to sell a large quantity of shares into a market with weak liquidity, that shareholder can considerably move share price.

1.1.7 Uncertainty

The movement of stock prices is also affected by a vague future. Prices do tend to bounce around a bit due to market apprehension and the unpredictable future. Because of the ambiguity of a company's future, volatility in stock prices is possible even without new information. This has been recently witnessed in the Kenyan market whereby the overall market performance for the first half of the year has been low as a result of the market recession experienced which significantly affected the NSE 20 share index causing a -20.33% during the first quarter of 2009 and a -17.45% fall in the second quarter of 2009. The overall first half performance of 2009 was -6.43%.

1.1.8 Inflation

History indicates that there had been a strong inverse correlation between low inflation and valuations. This is because low inflation propels high multiples, and high inflation drives low multiples.

The relationship between stock prices and inflation has been an intriguing anomaly for researchers. In an ideal scenario stocks should therefore be inflation neutral, and rising inflation should have no impact on stock valuations. This belief is based on two core assumptions as outlined in Giammarino (1999): 1) that companies can pass on one-for-

one costs; and 2) that the real interest rate that investors use to discount real cash flows does not rise when inflation rises. It also assumes that inflation has no long-term negative impact on growth.

The question of whether markets are efficient and if not, where the inefficiencies lie, is central to investment valuation. If markets are in fact efficient, the market price provides the best estimate of value and the process of valuation becomes one of justifying the market price. If markets are not efficient, the market price may deviate from the trade value and the process of valuation is directed towards obtaining a reasonable estimate of this value. Those who do valuation well will then be able to make 'higher' returns than other investors, because of their capacity to spot under and overvalued firms. To make these higher returns, markets have to correct their mistakes i.e. become efficient overtime. Whether these corrections occur over six months, or five years can have a profound impact in which valuation approach on investors chooses to use and the time horizon that is needed for it to succeed.

According to Fisher (1930) asset values should be positively related with expected inflation, providing a hedge against rising prices. If the implied positive relationship between stock prices and inflation does not hold, stock investors will be vulnerable to inflation, especially during rising economic cycles. The prediction that equity will act as an inflation hedge is sometimes referred to as the Fisher hypothesis. In reality, it is possible that equity is not a hedge because of imperfections such as taxes, or because inflation has an impact on expected nominal and or real cash flows.

Recent increases in energy and food prices along with the gradual evaporation of the inflation-calming effects of the 'globalization' supply shock that major emerging economies including Kenya have been enjoying ever since the early 1990s threaten to put global inflation in an upward trajectory. Although few would argue that a return to the highly inflationary 1970s is possible, given the major differences in policy regimes and underlying economic systems, nevertheless from an investor's point of view a re-examination of whether stock prices maintain their value relative to goods prices becomes increasingly important. According to the generalized Fisher hypothesis (GFE)

since stocks represent claims to real assets their real rate of return should be uncorrelated to the underlying inflation rate, a prediction consistent with the classical view of mutually independent nominal and real sectors (Fisher 1930).

1.2 Statement of the problem

In the Kenyan economy, the activities at the Nairobi Stock Exchange have gained importance in the last few years. The local equity markets have been opened up allowing for both the domestic and foreign investors. This has seen many new companies being listed at the NSE with the latest being Trans-Century Ltd and British American Investment Company (Kenya) Ltd.

Kenya has also experienced different macroeconomic conditions in the past including periods of both low and high inflation growth and both high and low economic growth. Potentially important relationships between inflation and stock prices in emerging equity markets have not been adequately studied, perhaps due to the lack of data pacicity (Adrangi et al., 2000). The varying levels of inflation recorded in the past could have had an effect on the operations of the NSE. The exact nature and magnitude of the effect is however not known. By examining the effects of inflation on stock price at the NSE, this study seeks to provide information that is of importance to policy makers and the general public on the effect of macro-economic factors on the operations of the stock exchange. This information is vital for institution of private and public policies aimed at strengthening the operations of the NSE.

The Nairobi Stock Exchange has been experiencing a bear performance during the year with the NSE 20 share index recording a negative return of 22% for the period of 2011 to end of August. The overall volumes traded have also significantly reduced as most of the foreigners have kept off due to the uncertainty in economic performance in both the US and Eurozone resulting to reduced overall foreign participation.

There has been increased concern on the high inflation currently being experienced in the economy mostly from the dry weather conditions experienced in the most part of this year 2011 translating to increased cost of food as the food inflation index on the overall

CPI basket increased by24% year on year during the month of August 2011. The overall increase in the international oil prices has also significantly contributed to the increased inflation levels being experienced. The international Brent Oil price has increased by 21% to 115.08 ($/Bbl) translating to a 24.31% year on year movement on the transport index in the CPI basket.

The overall effect is that the year on year inflation rate has touched on all time high of 16.67% during the amount of August 2011 using the newly revised geometric calculation methodology. This is composed of the new CPI basket which amended in October 2010 aimed at reducing the overall food weight from 50.5% to the current 36.04% of the CPI weight.

Various debates and research has emerged with new evidence of a negative relationship between stock prices and inflation. This finding is in contradiction of Fisher (1950) who argued that stock prices should be positively related with expected inflation providing a hedge against rising prices. This relationship has intrigued researchers who have attempted to explain how a nominal variable such as inflation should determine a real variable (asset prices). The proxy hypothesis, inflation illusion and effect of taxation on stock returns have been given as possible explanations for the negative relationship between inflation as stock prices. However, the findings on the validity of the Fisher hypothesis have been found to vary in different economics depending on the existing macro-economic conditions.

1.3 Objectives of the study

1. To establish the relationship between inflation rates and the stock price movements.

1.3 Significance of the study

The assumption of this study is that changes in inflation rate and equity investments cause's changes in stock prices and it will contribute to literature in several ways;

Financial Analysts:

1. The findings of this research will assist the fund managers to be able to offer sound advice to their clients on the current available investment opportunities available.
2. The fund managers will also be able to establish what works more efficiently.
3. An understanding of how inflation affects equity prices both in theory and in practice will assist financial analysts in thinking about their strategic and tactical asset allocations. From a strategic standpoint, analysts may wish to consider an allocation to assets that preserves purchasing power during inflationary periods. From a tactical standpoint, the rise of inflation provides additional incentive for investors to diversify by region and asset class, and to compare countries in terms of their inflation fighting capability

Academicians:

The study belongs to an expanding literature in that it will form a basis for future research in the academic world.

Investors:

1. The research aims to ensure that they are not misinformed on the investment decisions that they undertake.
2. The research will ensure that investors are in a better position to make better investment decisions.

Governments and policy makers

The research will assist the policy makers to effectively monitor the levels of inflation as a macroeconomic policy tool and its direct effect on the shareholders wealth.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section is devoted to reviewing relevant literature. The first part gives the empirical studies relevant to the study including various hypotheses explaining why P/E ratios tend to fall as inflation increases and the second part, the conclusion.

2.2 Empirical Study Review

Various empirical studies as presented below find that real stock returns are adversely affected by inflation and when actual inflation is decomposed into its expected and unexpected components, real stock returns are negatively related to both components. These findings are puzzling because they contradict economic theory and common sense. For example, the negative relation between real stock returns and unexpected inflation is inconsistent with the classical theory of monetary neutrality where inflation cannot affect real asset values. Since common stocks represent claims on future income produced by real assets, they should provide a perfect hedge against inflation whether anticipated or not. The negative relation between expected inflation and real stock returns violates both the classical view of monetary neutrality and the generalized Fisher hypothesis. Fisher (Fisher, 1930) argues that nominal returns on all assets should be perfectly correlated with expected inflation and therefore real returns and expected inflation should be independent.

Blanchard (1993) found that an unexpected increase in inflation in year 0 leads to a sharp decrease in stock prices in that year. Three other useful distinctions for investors to make are between the absolute level of inflation, the trend of inflation, inflation uncertainty, and inflation volatility (variability around trend.) Both the absolute level of inflation and the rate of change in inflation affect price earnings multiples and by extension, equity returns. He further states, "A high (equity) premium in the 1970s US stock markets is associated with a sharp increase in inflation, while a low premium is associated with a sharp decline in inflation". Four, Ritter and Warr (2002) found that, "Future real (equity) returns ...are negatively related to expected inflation". Five from 1978-1997, they found

that "A 100 basis point increase in expected inflation is associated with expected real returns being 242 basis points power over the next year".

Fama and Schwert (1977), analyzing the period 1953-1971, noted that common stock returns were negatively related to the expected component of the inflation rate, and probably also to the unexpected component. They concluded by rejecting the hypothesis that common stocks are a hedge against the expected monthly inflation rate.

Several explanations have been proposed to resolve these empirical anomalies but the extant literature predominantly focuses on the negative relation between real stock returns and unexpected inflation. Feldstein and Summers (Feldstein and Summers, 1979) for example, attribute the negative relation between real stock returns and inflation to the redistributive effect of unexpected inflation due to nominal contracting. Since taxes in the U.S. are levied on nominal income, higher inflation leads to higher tax liability and lower real after-tax return on equity for a given real before-tax income. While rational investors incorporate expected inflation's effect on equity, unexpected inflation should lower equity values.

Schwert (1989) looked at the relationship between stock market volatility and the volatility of real and nominal macro-economic variables. He examined the impact of the level of economic activity, financial leverage, and stock trading. He concluded that macroeconomic volatility as measured by movements in inflation and real output have weak predictive power for stock market volatility and returns. In particular, inflation volatility predicts stock market volatility only for the sub-period 1953-1987. His results point to a positive link between macroeconomic volatility including inflation rates and stock market volatility, with the direction of causality being stronger from the stock market volatility to macro-economic variables.

Davis and Kutan (2003) extended Schwert's study by accounting for volatility persistence in an international setting. Their results are in line with the findings in Schwert's paper in the sense that the variability of inflation and output growth rate has weak predictive power for conditional stock market volatility.

On the other hand, existing studies in the literature, for example Engle and Rangel (2005) provide evidence for the impact of the overall health of the economy on unconditional stock market volatility. By using Spline –Garch model they find that volatility in macro-economic factors such as GDP growth, inflation and short term interest rates are important explanatory variables that increase volatility. They observed positive relations among long term market volatilities and each of the following variables: emerging markets, inflation growth, and macroeconomic volatilities. In particular, they observe that emerging markets show larger expected volatility compared to developed markets and countries with high inflation rates experience large expected volatilities than those with those stable prices. Comparing the Spline – GARCH model results with those of annual realized volatility as an alternative measure of unconditional volatility.

Fama (1981) argues that the observed negative relation between real stock returns and inflation is spurious suggesting that stock prices and inflation are driven in opposite directions by random shocks in real activity. For example, a positive shock in real activity causes an increase in demand for money as economic agents adjust to the increase in economic activity. For a given level of money supply, the increased money demand must be satisfied through a reduction in current spending, which in turn causes a decline in commodity prices. At the same time equity prices rise with the shock as investors expect better business conditions in the future.

Geske and Roll (1983) supplement Fama's (1981) explanation by demonstrating that the observed negative correlation between real stock returns and inflation can also be produced by a **countercyclical monetary policy.** If the Federal Reserve accommodates a negative shock in real economic activity by increasing the money supply and this practice is built into the expectation of economic agents, a negative shock in real activity will produce a simultaneous decline in stock prices and an increase in inflation. Hasbrouck (1984) notes that Fama and Geske and Roll, can only explain the negative relation between real stock returns and unexpected inflation since any covariance between inflation and real stock returns originates from random shocks to real activities and therefore must be unexpected.

Sheshinski and Weiss (1977) suggest that real stock returns decline during inflationary periods because the unexpected part of inflation can increase various costs in the real economy. Other studies show that unexpected inflation has a positive effect on inflation uncertainty, which in turn adversely affects economic activity by increasing the cost of assimilating information and reducing the role played by the price system in guiding market activity (Evans and Wachtel, 1993), (Huizinga, 1993), and (Holland, 1995).

In theory stocks should be inflation neutral, and rising inflation should have no impact on stock valuations. This belief is based on two core assumptions as outlined in Giammarino (1999): 1) that companies can pass on one-for-one costs; and 2) that the real interest rate that investors use to discount real cash flows does not rise when inflation rises. It also assumes that inflation has no long-term negative impact on growth.

In practice, however, as inflation accelerates P/E ratios tend to fall. In the short-term, rising inflation has a negative impact on stock prices. However, based on stock indices in six industrial markets, Anari and Kolari (2001) concluded that "stock prices have a long memory from inflation shocks, such that investors should expect stocks to be a good inflation hedge over a long time period.

There are several theories as to why inflation negatively impacts equity prices and the precise dynamic remains a matter of considerable debate. A building block for the analysis is the Fisher effect. As Irving Fisher (1930) noted, nominal interest rates may be decomposed into an expected real rate and an expected inflation component. Fisher argued that the expected real return was determined by real factors, and is unrelated to expected inflation. But, Sharpe (1999) argued that rising inflation is accompanied by both 1) lower expected earnings growth and 2) higher required real returns: "A one percentage point increase in expected inflation is estimated to raise required real returns about one percentage point, which amounts to about a 20% decrease in stock prices."

Fama and Schwert (1977) argued that there is a reliable negative relationship between expected stock returns and the ex-ante interest rate which can be interpreted as a proxy

for expected inflation rate remains an economic enigma though we cannot as yet reliably conclude that it is evidence of market inefficiency

Hoguet (2008) however argues that there are two major schools of thought that have emerged as to why price-earnings ratios fall when inflation accelerates. One, which might be classified as the "behavioral" school, argues that investors make a cognitive mistake and improperly discount real cash flows using a nominal discount rate. Meanwhile, the "rationalist" school focuses on the distortions that a high level of inflation creates for reported profits; it also argues that inflation may affect several of the parameters, such as the risk premium, used to value securities in standard valuation models, such as the Gordon Growth Model.

The hypotheses below tend to explain why P/E ratios tend to fall as inflation increases:

2.2.1 Inflation Illusion Hypothesis

Modigliani and Cohn (1979) money illusion hypothesis requires equity returns to decline in periods of inflation because investors use nominal rates of return to discount real future cash flows. In a landmark paper, "Inflation, Rational Valuation and the Market," they argued that investors fundamentally undervalued stocks in the 1970s because of two important cognitive errors: 1) they use nominal interest rates to discount real cash flows; and 2) they do not take into account the capital gain that accrues to equity holders of firms with fixed rate debt liabilities. The authors maintain that, "One should capitalize the current level of adjusted profits at the very same real rate that prevailed before the inflation, even though the nominal interest rate will have increased".

Modigliani and Cohn (1979) claim that stock market investors (but not bond market investors) are subject to inflation illusion. Stock market investors fail to understand the effect of inflation on nominal dividend growth rates and extrapolate historical nominal growth rates even in period of changing inflation. Thus when inflation rises, bond market participants increase nominal interest rates which are used by stock market participants to discount unchanged expectations of future nominal dividends. The dividend-price ratio moves with the nominal bond yield because stock market investors irrationally fail to

adjust the nominal growth rate to match the nominal discount rate. From the perspective of a rational investor, this implies that stock prices are undervalued when inflation is high, and may become overvalued when inflation falls. The dividend yield that emerges from the interaction of national and irrational investors is positively correlated with inflation and the long term nominal interest rate. In recent work, Ritter and Warr (2002) supported this idea with a detail empirical analysis of the 1983-2000 bull market.

This critique is reminiscent of the critique of the "Fed Model." This model (which was never endorsed by the Fed) purports to compare the relative attractiveness of stocks to bonds by comparing earnings yields on stocks or E/P with ten year bond yields. As Asness (2003) argues, the "Fed Model" compares a real quantum, forward Earnings/Price ratios (E/P) to a nominal quantum, i.e. ten year bond yields. In other words, stocks are claims on real assets of a corporation; these assets can appreciate with inflation, as can earnings. A bond return is unambiguously a nominal return.

A more robust formulation would be to compare stocks and bonds via a modified formula, i.e. **E/P (Earnings/Price) - R (real bond yield) - RP** (a risk premium for stocks over bonds). (Asness also suggests a volatility term.) Wilcox (2007) further refines the concept by advancing the notion of the "Adjusted Earnings Yield." In this analysis, *current* earnings are adjusted for inflation-induced accounting distortions.

Ritter and Warr (2002) also find evidence that investors mis-value levered firms during inflationary times. Campbell and Vuolteenaho (2004) also argue that inflation is highly correlated with stock market mispricing, and that investors fail to adjust their expectations for earnings growth during periods of rising inflation. Lansing (2004) suggests that that the apparent failure of investors to discount expected cash flows using a real yield instead of a nominal yield constitutes a behavioral anomaly, similar to other behavioral anomalies recently commented on by finance academics.

It can be summarized that the critics of this hypothesis find it to be unappealing since it implies irrationality and is contradictory to empirical evidence which shows investors appropriately include inflation when projecting future cash flows.

2.2.2 The Proxy Hypothesis

Fama (1965) comes up with a proxy hypothesis further explaining the negative relationship between stock prices and inflation. The negative relationship reflects the deterrious effects of inflation on the real economic activity. As evidenced during the rapid inflation yeas of 1970's, the US stock price levels thus indicating that equities in the industrialized economies have failed to maintain their value during periods of high inflation.

Fama (1981) further argues that the relationship between high rates of inflation and future real economic growth rates is negative. He claims that the negative stock return inflation relation is spurious as a result of a negative relation between inflation and real activity. By contrast, there is a positive relationship between stock returns and anticipated growth rates of real economic activity. As inflation accelerates, investors anticipate slower and more volatile economic growth and require a higher risk premium. Investor expectations of more volatile macro-economic performance help to shape their perceptions of long term earnings growth.

Fama *et al* (1983) concluded that there is a negative relationships between the stock returns and inflation and refer to this as the 'proxy effect'. They explained the proxy effect in the sense that a reduction in the economic activity negatively affects the future corporate profits and stock prices. Fama, argues that the proxy effect vanishes when real economic activity does not fail because of inflation.

Sharpe (1999) argues that market expectations of real earnings growth, particularly in the long term, are negatively related to expected inflation. One reason may be a decline in productivity. Geske and Roll (1983) further propose a 'reverse causality' explanation arguing that a reduction in real activity often leads to increased fiscal deficits as the government's banks monetizes a pattern of fiscal deficits leading to increased money supply and finally increased inflation.

Adrangi *et al* (2002) who sought to investigate relationship between inflation, output and stock prices in Brazil conclude there is a negative relationship between stock prices and

inflation. They explain that the real stock returns may be adversely affected by inflation rates as inflationary pressures may threaten the future corporate profits and nominal discount rates rise under inflationary pressures, reducing current value of profits and consequently the stock returns. They also found long term evidence for the proxy hypothesis in Brazil.

2.2.3 The Risk Premium Increase Hypothesis

The risk premium on stocks increases during periods of high inflation. Periods of high inflation are frequently accompanied by distortions to earnings. In theory, companies should be able to pass on higher price increases; in practice there may be significant time lags in the pass through or the pass through may not be complete. Companies need to correctly anticipate changes in the price level and consumers may not be willing to pay the markup. Inflation also can distort economic activity. For example, in the 1970s as individual investors were pushed into higher tax brackets through nominal wage increases, tax shelters proliferated.

Hoguet (2008) argues however that inflation can provoke a sub-optimal policy that can distort the pricing mechanism. For example, in 1971 the US imposed wage/price controls for a period of 3 years. Importantly, rising inflation is frequently associated with rising volatility of inflation. Devruex and Yetman (2002) found that Profit maximizing firms respond to higher trend inflation by increasing the average frequency with which they set prices. As a result, inflation volatility is increasing in trend inflation, since price shocks are transmitted more rapidly when a higher portion of firms update their prices each period.

2.2.4 The Inflationary Distortions to Reported Profits Hypothesis

Hoguet (2008) found that high and persistent inflation has a multiple impact on reported profits. On the other hand, profits may be overstated because of the inadequate depreciation expense. Inventory gains may also help to overstate profits. On the other hand, profits are understated to the extent that inflation reduces the real burden to companies with fixed-rate liabilities. At a minimum, inflation renders more complicated the analysis of financial statements, as it becomes harder for analysts to disentangle nominal versus real profits. In the US, the situation became so acute in the 1970s that,

from 1976 to 1978, the SEC encouraged companies to report on the estimated current replacement costs of inventories and gross property, plant and equipment.

Feldstein (1980) argues that higher inflation in the US led to a higher effective tax rate on corporate income caused by historic cost depreciation. "As a result, real profits net of the corporate income tax varies inversely with inflation." In addition, he argued that taxable investors required that they pay less for shares when inflation was high because, via bracket creep and other mechanisms, investors' effective capital gains rate rose, while their after tax returns fell.

2.2.5. The Fed Model

Campbell and Wolteenaho (2004) using the 'fed model' conclude that the level of inflation explains almost 80% of the time series variations in the stock market mispricing. The Fed model of equity valuation states that the bond and stock market are in equilibrium, and fairly valued, when the one year forward looking earnings yield equals the 10-year Treasury note yield that is:

$E/P = (Y10)$

Where E = Earnings, P = Equity Price and (Y10) = 10 Year Treasury note yield.

According to the model, stocks and bonds compete for space in investors' portfolios such that if the yield on bonds rises, then the yield on stocks must also rise to maintain the competitiveness of stocks. The model is often augmented to include a measure of the relative risk premium which defines a "normal" yield on stocks, and that the actual stock yield tends to revert to this normal yield. If the measured stock yield exceeds the normal yield defined by the Fed model, then stocks are attractively priced and if the measured yield falls below the normal yield, then stocks are overpriced.

The Fed model implies that stock yields are highly correlated with inflation though historically, the major influence on nominal bond yields has been the rate of inflation. In the late 1990s practitioners often argued that falling stock yields, and rising stock prices were justified by declining inflation.

As pointed out by Asness (2000, 2003), the Fed model has been quite successful as an empirical description of stock prices. Most notably, the model describes the rise in stock yield, along with inflation, during the 1970's and early 1980's and the decline in stock yields during the past 20 years. The study concludes that inflation is highly correlated with mispricing, supporting the Modigliani-Cohn (1979) view that investors form subjective growth forecasts by extrapolating post nominal growth rates wit out adjusting for changes in inflation.

2.2.7 Dividend Discount Model (DDM)

The relationship between stock prices and macro-economic variables is well illustrated by the **Dividend Discount Model (DDM)** proposed by Miller and Modigliani (1961) than any other theoretical stock valuation model. According to the model the current price of an equity share equals the present value of all future cash flows to the share. Thus, the determinates of share prices are the required rate of return and expected cash flows (Oyama, 1997, Gan et al 2006,Humpe and McMillan, 2007 Leibowitz, Sorensen, Arnott and Hansen, 1989, and Tessaromatis, 2003) suggesting that economic factors that influence the expected future cash flow and required rate of return affect the share price. Fama and Gibbon (1982) find that expected real returns on bills and expected inflation rates are inversely related. This is due to the positive correlation between expected real returns on financial assets and real activity.

2.2.8 Others

Modigliani and Cohn (1979) suggest that investors collectively suffer from **money illusion** in the presence of inflation. They used the nominal rate to discount real cash flows failing to adjust the nominal growth rate of dividends and secondly they fail to recognize the capital gains accruing to the equity holders of firms with fixed cost liabilities thus the subsequent fall in the value of stocks.

The limited study on the real stock return-expected inflation relationship has left the anomaly unresolved for several decades. Schwert (1981) has labeled the relationship as "the most puzzling result of all" and depending on the proxies used for expected inflation, the statistical strength of the relationship differs across studies. For example, if expected

and unexpected inflation is derived from time series models of actual inflation or from Treasury bill yields, the negative relationship is largely found to be significant (Jaffe and Mandelker, 1976) and (Nelson, 1976). However, if expected inflation is measured using Livingston survey data no statistically significant negative relationship exists (Gultekin, 1983) and (Hasbrouck, 1984). Since the empirical results are sensitive to the proxies used for expected inflation, the true nature of the relationship between real stock returns and inflation cannot be viewed as definitive.

Summers (1980) seeks to offer explanations for the sharp decline in the value of the stock market as a result of increased levels of expected inflation. He concludes that increased inflation raises substantially the **tax burden** on the corporate capital as a result of historic cost depreciation, FIFO inventory accounting and the taxation of nominal capital gains. With the increase in the effective tax rate, this is capitalized into an immediate decline in the price of corporate capital affecting most of the institutional investors who form the biggest investors in most stock markets.

Anokye *et al* using the **cointegration analysis** came to the conclusion that inflation positively relates to the data bank stock index in Ghana. Their study was consistent with the findings of Anari and Kolari (2001), Luintel and Paradyai (2006) and Gulteking (1983), that the stock market partly or full provides a hedge against inflation.

Using the **multi-factor APT framework**, Hamao (1988) shows that inflation significantly influenced Japanese stock returns. An investigation of the relationships between stock prices and real activity, inflation and money conducted by Fama in 1981 shows a strong positive correlation between common stock returns and real variables. Kaneko and Lee (1995) and Lee (1992) find similar results. By examining the relationship between inflation and stock prices in 16 industrialized countries, Rapach (2002) argues that increase in inflation does not result in persistent depreciation of share real value.

Ram and Spencer (1983) using their empirical tests based on an **Augmented Fisher - Philips relationship** shows that some of Fama's findings may be reversed. The Philips curve shows the relationships between a measure of real economic activity, Such as the

rate of growth of real output or unemployment and a nominal variable such as the inflation rate. According to the Philips Curve, higher rates of unemployment are associated with lower inflation rates and vice versa. The Philips curve shifts to the right as inflationary expectations are formed and demand for higher nominal wages reduce employment at any given inflation rate. Consequently, higher inflation rates may be associated with lower real economic activity because of the inflationary spiral thus reduced stock prices.

The **Keynesian view** further indicates that higher rates of inflation may stunt new investments thus reducing both the aggregate demand and supply and consequently, the real output. On the other hand, increased real economic activity leads to increased profitability and consequently rising stock prices. It can therefore be concluded that inflation and real economic activities may be considered as exogenous variables while with the real equity returns being the endogenous variables.

Bondoukh and Richardson (1993) established that in the short term (1 year) horizon, nominal stock returns and inflation are approximately uncorrelated while in the long term (5 years) the Fisher equation holds. Other studies have also concluded that there is a negative relationship between inflation rates and the stock prices as reflected in divided price ratio and price earnings ratio include (Feldstein, 1980), Ritter and Warr (2003), Sharpe (2002) and Campbell and Voulteenaho (2004).

Empirical tests of these hypotheses are generally supportive except in the case of the **nominal contracting hypothesis**. The evidence is particularly favorable for the explanations offered by Fama (1981) and Geske and Roll (1983). Substantial research provides strong evidence supporting their conjecture that, in the short run, monetary policy has significant and important effects on stock returns (James *et al* 1985), (Kaul 1987), (Patelis 1997), and (Thorbecke, 1997).

In contrast to the extensive studies on the negative relation between real stock returns and unexpected inflation, the effort devoted to another piece of the puzzle, the negative relation between real stock returns and expected inflation, is noticeably scant. The limited

explanations offered in the literature are not intuitively appealing and have received little empirical support. For example, the Lintner (1975) external financing hypothesis implies that firms dilute return on equity by increasing working capital during inflationary periods in an attempt to maintain working capital to sales ratios. This hypothesis is inconsistent with the observed phenomena that firms respond aggressively to increases in inflation by reducing cash balances, tightening credit terms and delaying payments.

2.3 Conclusion

Various researchers have sought to explain the relationship between the inflation rates and the stock price movements. The major studies include, Schwert (1989) who looked at the relationship between stock market volatility and the volatility of real and nominal macro-economic variables concluding that macroeconomic volatility as measured by movements in inflation and real output have weak predictive power for stock market volatility and returns. The Dividend Discount Model (DDM) advanced by Miller and Modigliani (1961) proposes that the current price of an equity share equals the present value of all future cash flows to the share. Thus, the major determinates of share prices are the required rate of return and expected cash flows. Modigliani and Cohn, (1979) came up with the money illusion hypothesis that requires for equity returns to decline in periods of inflation because investors use nominal rates of return to discount real future cash flows as they fail to understand the effect of inflation on nominal dividend growth rates hence extrapolate historical nominal growth rates even in period of changing inflation.

Fama, Geske and Roll (1983) found that there is a negative relationships between the stock returns and inflation and refer to this as the 'proxy effect' and explain it in the sense that a reduction in the economic activity negatively affects the future corporate profits and stock prices which is contrary to the Fed model which implies that stock yields are highly correlated with inflation. The Inflationary Distortions to Reported Profits Hypothesis is a theory proposed by Hoguet (2008) and Feldstein (1980) and explains that the risk premium on stocks increases during periods of high inflation which are frequently accompanied by distortions to earnings and that importantly, rising inflation is frequently associated with rising volatility of inflation. Hoguet (2008) found that high and persistent inflation has a multiple impact on reported profits while on the one hand,

profits may be overstated because of the inadequate depreciation expense, a theory which is also supported by the Decline in Profitability Hypothesis.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter present the methodology employed to examine the effects of changes in the level of inflation on stock prices of the rise. A theoretical framework for the study is first outlined followed by the specification of the empirical model. The variables used in the study are explained, including sources of data and diagnostic test employed on the data.

3.2 Theoretical Framework

The relationship between stock prices and inflation is illustrated in the context of a Dividend Discount Model (DDM). According to the DDM, models, investors will set the price of a stock (St) at time t, to a point where the expected return on the stock is equal to the required rate of return.

Assuming a world with no inflation, and a company is expected to generate a real cash flow of C per period in perpetuity. Also assuming that the firm pays out all free cash as dividend, the current price or a stock P_{o4} can be calculated by dividing the dividend (D) by the required rate of return (K_s) as follows:

$P_o = D/K_s$ ..... (3.1)

An increase in the expected inflation brings about two major changes; the cash flows of the company may change as the general inflation acts on both, revenues and expenses. Also the discount rate will change to the nominal rate (Kn) defined as;

$Kn = (I + Kt)(1 + I)$ .....(3.1.1)

Where: Kt is the real rate of return given that expected inflation (1) is at some positive value. If the cash flows grow at a constant growth rate (g). The nominal price (P_n) can be obtained as follows:

$$P_n = \frac{D}{K_s} - g \quad \text{.....(3.2)}$$

The discount rate depends on the level of inflation, demand pressure and risk. The negative relationship between inflation and stock prices arises from the fact that, as the required rate of return (K_T) increases, the price of the stock decrease since K_s is the denominator in the above operation, any increase in the demonolater will decrease the current price. Equity is ledge against inflation if $P_o = P_1$ or

$$\frac{D}{K_s} = \frac{D_1}{K_s} - g$$

In order to conclude that equity is an inflation ledge, the following assumptions must be made. Nominal cash flows must be equal to real cash flows multiplied by the inflation growth factor. The real interest rate must be independent of expected inflation.

The prediction that equity will act as an inflation hedge is what constitutes the fisher effect. The fisher effect expresses the nominal rate of interest (i) as the sum of real rate of interest plus the inflation rate.

$$1 + r = (1 + R)(1 + 1)$$

$$r = R + I + RI$$

Where

R = is the real interest rate

I = is the rate of inflation per annum expected to prevail over the life of the security.

RI = is the multiplicative component which is assumed to be small and which can therefore be ignored.

The equation above then changes to:

$r = R + I$

Generally, the fisher effect states a nominal rate of interest has embedded an inflation premium sufficient to compensate investors.

3.3 Empirical studies

This study investigates the relationship between real returns and inflation in Kenya for the sample period; in order to assess the validity of the Fisherian Hypothesis at the NSE. This study employs a .nodel used by Fama and Schwert (1977) to test the Fisherian Hypothesis at the NSE. The model is formulated on the assumption that stock markets are efficient and that real returns and inflation rate vary independently of each other. The empirical test of the Fisherian Hypothesis is accomplished by estimating the equation below;

$R_i - INF_1 = \alpha + \beta(eiNF, / \Omega_{t-1}) + \sum i$ ..... **(3.5)**

Where:

R_t – INF_t – is the real return, (the difference between the nominal return R and the inflation rate $EINF_1$) $EINF_t$ – is the expected inflation E – Is the error term assumed to be randomly and normally distributed with zero mean and constant standard deviation.

Basing on the understanding that equities and bonds are claims against real assets and are often considered a potential hedge against unexpected as well as expected inflation, Adrangi et al (2000) propose the following extension of equation (3.5), which includes the unexpected inflation rate, which is viewed as a more appropriate formulation of the Fisherian hypothesis.

$Rt - INFt = \alpha + Bi\ (EINFt / \Omega 1\ 1 - 4) + B2(UINFt / \Omega t - 1) + \sum i$

Our equation (3.5.1) is however modified as below;

$ST = \alpha + B1\ CP + B_2 INF + B_3 EINF + E$ ..... **(3,5,2)**

Where:

ST – NSE Stock Prices

CP – CPI

INF – Inflation movement

EINF – Expected Inflation

E – Is the error term assumed to be randomly and normally distributed with zero mean and constant standard deviation

Basing on the Fama and Swert (1977) framework, equities are a hedge against expected inflation if $B_1 = 0$ and a perfect hedge against expected and unexpected inflation if $B_1 = B_2 = 0$ which would support the Fisherian Hypothesis.

3.4 Estimation Techniques

Equation (3.5.2) was estimated using Ordinary Least Squares (OLS) estimation method. Before estimation, diagnostic test was conducted on the time series variables. The decision to use a time series variables is because of its predictive power. A specification associated with Error Correction Modeling (ECM) was applied. By using co-integration and error correction model, the study establishes both the short run and long run equilibrium. The appropriate test for stationary of all the variables was performed to avoid spurious regression results. Variables not stationary at levels were differenced to achieve their stationarity. Cointegration test far series with higher order of integration were performed.

Unit Root tests

Economic time series data may exhibit a trend or unit root (s) over time. A time series is stationary if its mean and variance do not vary systematically over time (Gujarati, 2003). A stationary stochastic process implies that the underlying stochastic process that generated the series is invariant with time. The results that come from an econometric analysis when using non-stationary series are ambiguous (Philips 1986).

Granger and Newbold (1974) ascertained that non-stationary time series produce "spurious regression" results where results may suggest statistically significant relationships when in reality there are no meaningful relationships between the variables. In the presence of unit roots, one may detrend the series or difference the data to remove the non-stationary (deterministic) trend in it. However, this may lead to a loss of some vital long-run information contained in the data or it may only partially solve the problem. (Harris, 1995). A way around this shortfall is differencing which was proposed by Dickey and Fuller (1981). This is known as the Augmented Dickey – Fuller (ADF) test. It tests for the existence of systematic and linear relationships between past and

present values of variables. The Dickey-Faller and the ADF are applied to regressions run in the following forms:

$$Dy_t = B_t + B_2\ T + \ell Y_{t-1} + \Sigma_t \quad \text{.....(D}_f \text{ regression)}$$

$$Dy_t = B_t + B_2\ T + \ell Y_{t-1} + \sum_{t-1}^{n} D\gamma_{t-1} + \Sigma_t \quad \text{.....(D}_f \text{ regression)}$$

Where T is the time trend variable and $\sum i$ is the error term which is independently and identically distributed. In each equation, the null hypothesis is that $\delta = 0$, that is, there exists a unit root in Y_t. The acceptance of the null hypothesis confirms the above considering that it takes into account both the stochastic trend and constant rather than just assuming that there exists a stationary trend. Furthermore, since the data generating process for the model is unknown, the use of this equation ensures that the deterministic components present are taken care of as much as possible.

Co-integration Analysis

According to Engle and Granger (1987) a linear combination of two or more non-stationary series may yield a stationary series. If such a linear combination exists, then the non-stationary series are said to be co-integrated. This means that the non-stationery series move closely together over time, and the difference between them is stable. The resultant linear combination is called a co-integrating equation, and it may be interpreted as a long-run relationship between the variables.

Following the work of Engle and Granger (1987) the co-integrating regression is specified as follows;

$$X_t = \alpha_0 + \alpha, z + \Sigma_t$$

The residual of the equation $\sum i = (xi - \alpha o - \alpha, Zt)$ is simply the I (i) series. If the residuals from the linear combination of non-stationary series are themselves stationary, then it is accepted that the I (i) series is co integrated and the residuals taken from the co-integrating regression as valid which are then built into an Error Correction Model (ECM). An ECM is a restricted autoregression that has co –integration restrictions built into the specification, so that it can be used for co-integrated non-stationary times series.

It restricts the long-run behavior of the endogenous variables to converge to their co-integrating relationships, at the same time allowing for short-run dynamics. The co-integrating term is known as the error correcting term and it shows the speed with which short-term deviations are corrected gradually towards the long-run equilibrium. A multivariate co-integration technique will be used to test for co-integration and applied in Johansen and Jeselius (1990).

3.5 Diagnostic tests

Diagnostic tests are typically used as a means of indicating model inadequacy or failure. For example, in the case of a linear regression model which is estimated by OLS, a series of diagnostic test could be used to indicate whether any of the assumptions required for OLS to be the Best Linear Unbiased Estimator (BLUE) appear to be violated. These assumptions include a serially uncorrelated and homoscedastic error term, absence of correlation between the error term and the regressors and correct specification of the model. Applied econometric can be viewed as consisting of a number of steps, including specification of the model (S), estimation and model evaluation.

Diagnostic testing plays an important role in the model evaluation stage of econometric studies of various diagnostic tests including AR for errors, normality test for the distribution of the residuals and the Ramsey Reset Test for the regression specification.

3.6 Sample Population

The population of this study will consist the 56 listed companies at the Nairobi Stock Exchange as at September 2011 and the Overall inflation movement.

3.4 Sample Frame

The sample selected will be two companies per sector where applicable of all the NSE share constituents have been selected so as to ensure that there is no selection bias of the data and to give a representative sample. The data will consist of the average monthly observations of the stock price movements of the 20 selected listed companies making up the NSE 20 share index.

3.5 Type and Source of data

The study will use published data for a period of ten years from 2000 to 2010. The data will be collected from The Nairobi Stock Exchange. The Inflation data will be sourced from the central bureau of statistics and government of Kenya publications. Inflation will be measured as the actual consumer price index (CPI) and the year on year change in the CPI. Another variable which is the expected inflation will also be used.

CHAPTER 4

DATA ANALYSIS

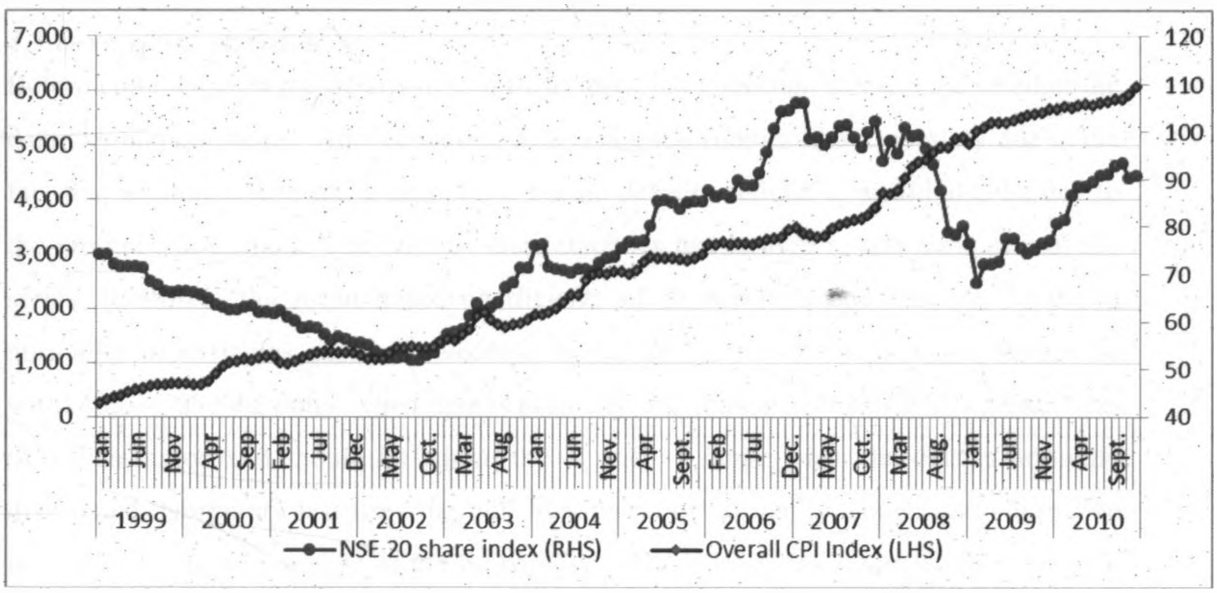
4.1 Introduction

The chapter presents the analysis and the empirical statistical of the study. The chapter commences with trending the variables and descriptive statistics, which gives the normality tests of the series among other statistics. The time series properties of the variables then follow and finally, regression results and diagnostic tests are presented respectively.

4.2 Variables Trends

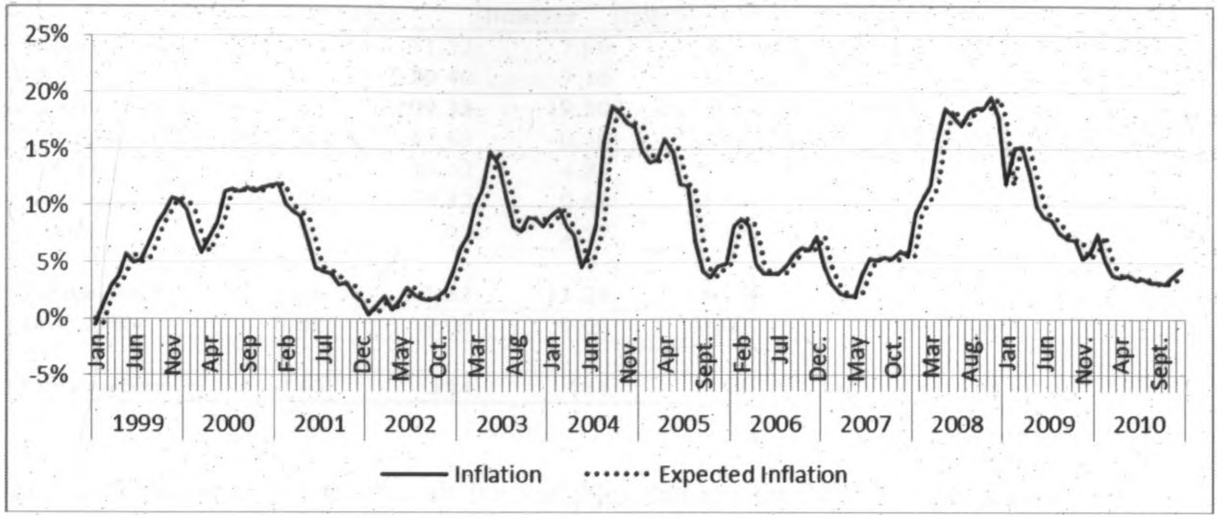
Before disusing time series properties of the variables, their trends were first analyzed. The figure below graphs the NSE 20 share index trend and the inflation rate trend for the period under study.

Figure 1: Trend of NSE 20 share index and the overall CPI index movement.



The NSE 20 share index has averaged 3146.45 and the CPI Index has averaged 71.52 for the period under study.

Figure 2: Trend of Inflation and the Expected Inflation rate movement.



The graph below graphs both the actual rates of inflation being the year on year change in the CPI index and the expected inflation which is the actual inflation in period T +1.

4.3 Descriptive statistics

Before embracing on the details of empirical tests, it's important to examine whether the data exhibits normality. Most economic data is skewed (non-normal), possibly due to the fact that economic data has a clear floor but no definite ceiling. It would also be due to the presence of outliers. The Jarque –Bera statistics test is used to test normality of the series. It utilizes the mean based coefficients of Skewedness and Kurtosis to check normality of variables used. Skewedness is the tilt in the distribution and should be within the -2 and +2 range when data is normally distributed. Kurtosis is the peakedness of a distribution and should be within the -3 and +3 range when the data is normally distributed. Normality test uses the null hypothesis of normality against the alternative hypothesis of non-normality. If the probability value is less than Jarque-Bera chi-square at the 5% level of significance, the null hypothesis is not rejected.

Table 1: Descriptive statistics of the data used in the study

	NSE 20 Share Index	Overall CPI Index	Inflation	Expected Inflation
Mean	3146.45	71.52	7.96	7.93
Median	2964.50	70.40	7.15	7.15
Maximum	5774.00	109.38	19.50	19.50
Minimum	1043.00	42.85	-0.40	-0.40
Std. Dev.	1313.10	20.02	4.87	4.91
Skewness	0.24	0.42	0.65	0.63
Kurtosis	1.98	1.90	2.57	2.55
Jarque-Bera	7.68	11.53	11.35	10.72
Probability	0.02	0.00	0.00	0.00
Observations	144	144	144	144

The normality test showed that all the variables that are the NSE 20, the overall CPI index, the inflation rate and the expected inflation are all normally distributed. The descriptive statistics above provide a guide on which of the equation is more able to yield better results and highlight on possible problems to encounter – (Otto, 1994). However, there is need to supplement the statistics by more incisive qualitative analysis such as the correlation matrix.

4.4 Unit Root Tests

Non-stationarity of time series data has often been regarded as a problem in empirical analysis. Working with non-stationary variables leads to spurious regression results from which further inference is meaningless. The first step was therefore to test for stationary of the variables. Augmented Dickey fuller (ADF) tests were used to test for stationary of the series. The results are presented below;

Table 2: Unit Root Tests

VARIABLE	ADF (2)	CRITICAL VALUE 1%	CRITICAL VALUE 5%	CRITICAL VALUE 10%	ORDER OF INTEGRATION
NSE 20 Share Index	-5.71	-3.48	-2.88	-2.58	Ex-I(1)
Overall CPI Index	-6.21	-3.48	-2.88	-2.58	I(1)
Inflation	-2.99	-3.48	-2.88	-2.58	I(0)
Inflation	-6.25	-3.48	-2.88	-2.58	I(1)
Expected Inflation	-3.02	-3.48	-2.88	-2.58	I(0)
Expected Inflation	-6.25	-3.48	-2.88	-2.58	I(1)

The tests show that all the variables are stationary after first differencing while both actual and expected inflation are stationary at levels at the 5% and the 10% critical levels. To confirm co integration, the Engle-Granger Two Stage Procedure is employed. The following long run equation is thus estimated.

$$ST = B_0 + B_1\ CP + B_2 INF + B_3 EINF + \epsilon_i$$

Where:

ST – NSE Stock Prices

CP – CPI

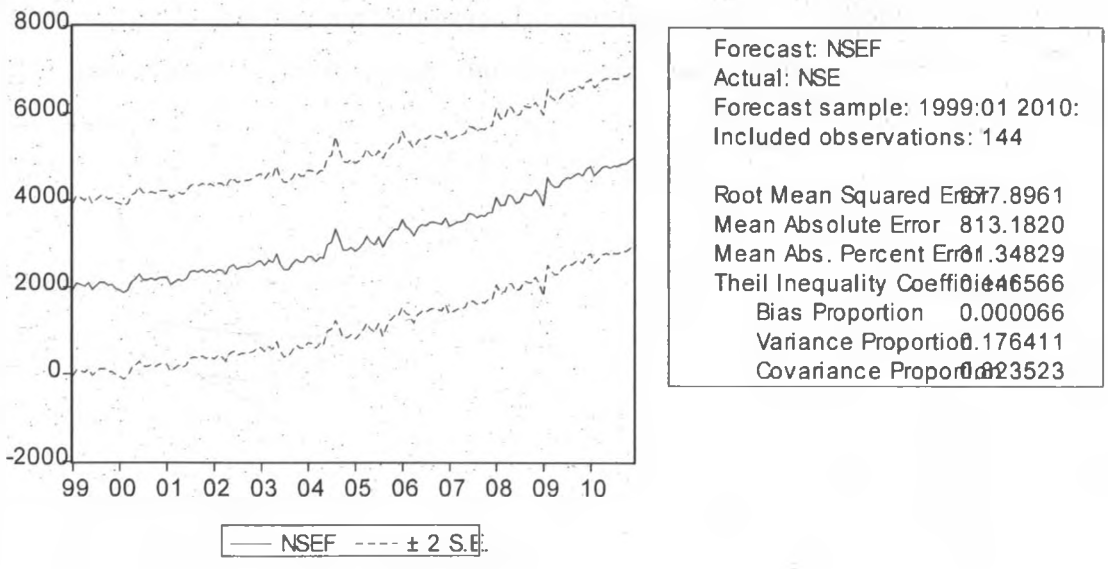
INF – Inflation movement

EINF – Expected Inflation

ϵi – Is the error term assumed to be randomly and normally distributed with zero mean and constant standard deviation

The forecast value of NSE 20 share index is shown below;

Fig 3. Forecast value of the NSE 20 share index



Using the forecast inputs, the residuals are obtained as follows;

ECM= NSE-NSEF

We apply the unit root test on the residual (ECM) and the results are as follows:

Table 3 Unit root test on ECM

Unit root test on ECM				
D(ECM(-2))	0.10649	0.085638	1.24346	0.2158
C	51.40708	45.14318	1.13876	0.2568

A drawback in differencing a non-stationary time series in an attempt to achieve stationarity is that the exercise results in loss of valuable long term relationship between the variables. In the circumstance, in order to carry out a meaningful study, we must find out an approach which will allow the definition of the relationship in terms of variable levels and avoid the problem of spurious regressions. Co-integration has been suggested as a remedy to this problem. The theory was developed by Granger (1981) and elaborated by Engle and Granger (1987) as cited in Gujarati (2003).

As from the results above, the residuals exhibit excess negativity after first level differencing and thus they are stationary. This confirms a long run equilibrium among the I(1) variables and thus justify a short run Error Correction relationship as follows:

$$\Delta St = \beta_0 + \beta_1 \Delta CP + \beta_2 \Delta INF + \beta_3 \Delta EINF + \beta_4 ECM(-1) + \in_t$$

Where, Δ is the difference operator.

ECM (-1) is the Error Correction Mechanism

4.5 Diagnostic Checks

A) Multicollinearity

Mukras (1993) asserts that multicollinearity arises from the presence of independence or lack of independence among the explanatory variables in a multivariate regression model. The test for multicollinearity used in this study is the correlation matrix which is shown below.

Table 4: Correlation matrix

	D(NSE)	D(CPI)	D(INFLATION)	D(EXPECTED)
D(NSE)	1			
D(CPI)	-0.100083	1		
D(INFLATION)	-0.016017	0.658922	1	
D(EXPECTED)	0.107711	0.267064	0.353715	1

The correlation matrix tests whether there is a relationship between the explanatory variables. Correlation below 0.5 indicates no multicollinearity and those greater than 0.5 show degree of multicollinearity. However, if the results are in excess of 0.8, it's concluded that there is a serious multicollinearity. According to the data above, there exists a strong multicollinearity between the differenced inflation and CPI variables.

B). Residuals Tests

Examination of the residuals is a good visual diagnostic to detect autocorrelation or Heteroskedasticity. Residual tests test the behavior of the error term. In this study, the tests include Histogram-normality test, serial correlation test and the white Heteroskedasticity test.

1. **Serial correlation LM test**

The test finds out whether the residuals are serially correlated , that is whether there is presence of autocorrelation. The null hypotheses are that the residuals are not correlated. The Breusch-Godfrey serial correlation test shows the probability of 0.12027 at the second lag. The value is insignificant thus we accept the null hypothesis and conclude that there is no autocorrelation.

Table 5: Breusch-Godfrey Serial Correlation LM Test

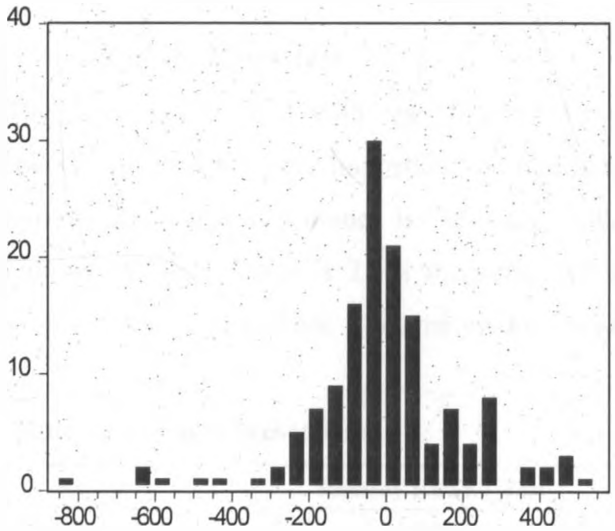
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	2.15138	Probability	0.12027
Obs*R-squared	4.38548	Probability	0.11161

2. Histogram Normality Test

OLS assumes that the random variable or error term is normally distributed around a zero mean and a constant variance. Absence of this implies that the OLS estimates are still BLUE but we cannot access their statistical reliability by classical tests of significance. The test finds out whether the variables are normally distributed or not. The null hypothesis for the test is that the model is normally distributed .The test uses the Jarque-Bera statistics under the null hypothesis of normality.

The Jarque-Bera probability is 0.000 which is insignificant and thus we fail to reject the null hypothesis and conclude that the residuals are normally distributed.

i) Fig 4: Histogram-Normality Test



3. White Heteroskedasticity Test (no cross terms)

The assumptions of homoscedasticity may imply that the residuals have a common variance. The violation of this assumption is known as Heteroskedasticity. The consequence of Heteroskedasticity are two fold, the estimates of the regression parameters are still unbiased but inefficient, and the estimates of the variances are biased.

The test is for non-homoscedasticity of the error term. The null hypothesis for the test is homoskedasticity or the variance of the error term is zero. The test shows that the

probability of the F-statistic is 0.001385 and it's insignificant. This means that we fail to reject the null hypothesis and say that there is homoskedasticity or the variance of the error term is constant.

Table 6: White Heteroskedasticity Test:

White Heteroskedasticity Test			
F-statistic	3.39841	Probability	0.00139
Obs*R-squared	24.11967	Probability	0.00219

C) Stability Tests

To ensure that the model is stable, the following tests are applied: Ramsey Reset test, Cusum test and Recursive Coefficients test.

1. **Ramsey Reset Test**

The test is concerned with specification errors. It tests whether the model is well specified to check if any important variable has been omitted from the model. The null hypothesis is that the model is well specified. The probability is 0.00020 when the number of fitted terms is 2. In this case, we fail to reject the null hypothesis as the probability is insignificant. Thus the model is well specified.

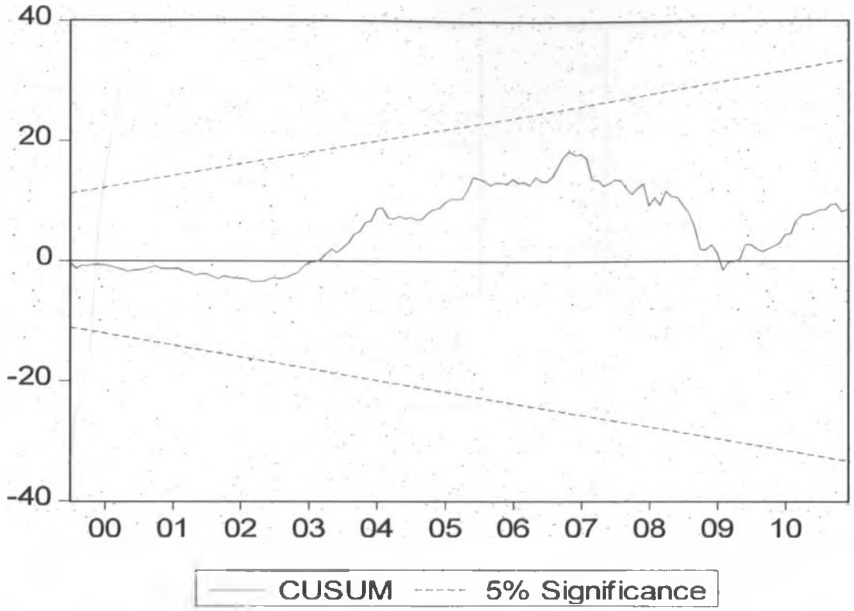
Table 7: Ramsey Reset Test

Ramsey RESET Test			
F-statistic	9.05569	Probability	0.00020
Log likelihood ratio	17.87796	Probability	0.00013

2. **Cusum Test**

This tests the stability of the model at 5% level of significance. Our model according to the below figure is seen to be stable. This means that the model is not sensitive to changes in the size of the sample.

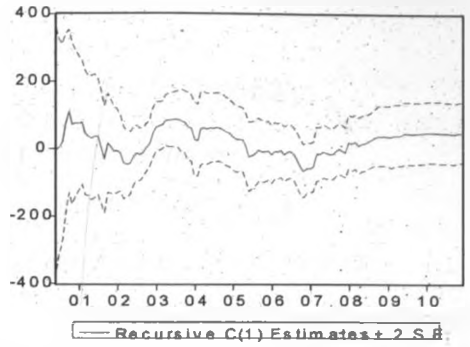
Fig 4: Cusum Test graph

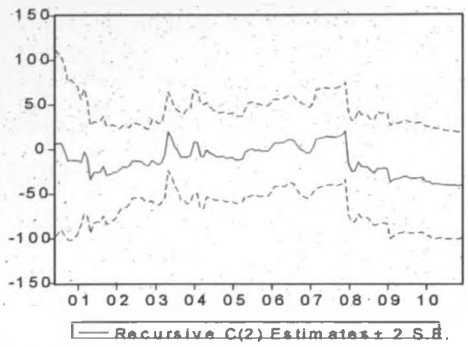


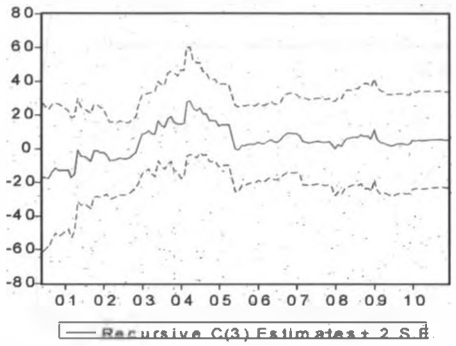
3. Recursive Coefficients

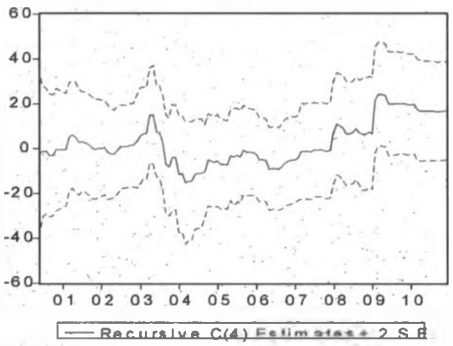
This is concerned with whether the coefficients of the model are stable at 5% level of significance. C(1) shows the stability of the constant coefficient while C(2) to C(4) shows the stability of the explanatory variables and C(5) is the stability of ECM. All of the coefficients are within the boundaries thus the variables are stable.

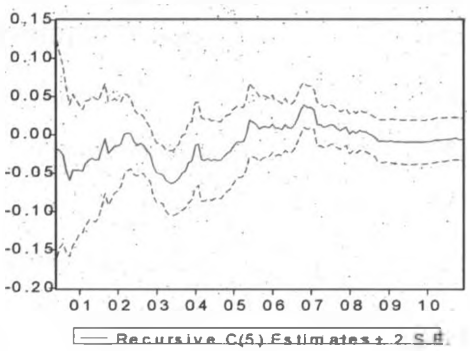
Fig 4.6 Recursive Coefficients











We finally present the regression results in the table below:

TABLE 8: REGRESSION TABLE

Dependent Variable: D(NSE)

Method: Least Squares

Date: 11/03/11 Time: 10:34

Sample(adjusted): 1999:02 2010:12

Included observations: 143 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	46.68341	45.03970	1.036495	0.3018
D(CPI)	-40.90351	29.68966	-1.377702	0.1705
D(INFLATION)	4.886845	14.18015	0.344626	0.7309
D(EXPECTED)	16.68357	11.00031	1.516646	0.1316
ECM(-1)	-0.005912	0.013715	-0.431042	0.6671

R-squared	0.031883	Mean dependent var	10.13706
Adjusted R-squared	0.003822	S.D. dependent var	208.6674
S.E. of regression	208.2683	Akaike info criterion	13.54987
Sum squared resid	5985845.	Schwarz criterion	13.65347
Log likelihood	-963.8157	F-statistic	1.136200
Durbin-Watson stat	1.692772	Prob(F-statistic)	0.342101

4.4 Regression Results

The R-squared is used to measure the fraction of the variation of dependent variable that is explained by the regression equation. This it is used to compare the validity of the regression results under alternative specification of the independent variable I the model (Mukras, 1993). In the model, the coefficient of variation (R^2) equals 0.031883. This means that only 3% of the changes in the explanatory variable can be explained by the changes in the predictor variables, leaving 97& unexplained.

The adjusted R^2 is an unbiased measure. It is adjusted so that the R-squared does not increase with increasing sample. The adjusted R-squared is 0.003822. The p-value (F-Statistic) of 0.342101 shows that the model is significant at 5%, implying that the explanatory variables in the model are jointly significant.

The trend line multiple regression model using the regression coefficient gives:

NSE = 46.68341 - 40.90351CPI + 4.886845 INFL +16.68357 EXP INFL - 0.005912 ECM(-1)

There is a direct relationship between INFL and Expected Inflation and the NSE 20 Share index. On the other hand, there is a negative relationship between the NSE 20 Share Index and the CPI index. The individual significant test using P-value of the t-statistics show that CPI and EXP INFL are linearly related to the NSE, while INFL is not related hence should be dropped from the model.

The modified model becomes:

NSE = 46.68341 - 40.90351CPI +16.68357 EXP INFL - 0.005912 ECM(-1)

The coefficient of CPI bears a negative exchange rate meaning that a higher CPI index leads to a fall in the NSE index. This is as expected as one would expect that the month on month movement in the NSE 20 stock index will be determined to some extent by the movement of the CPI basket such that as the CPI increases, then investors will stay away

from investing at the stock market hence depressing the overall stock prices as they look for alternative investment avenues such as the Interest Bearing Assets which will give higher returns from the higher risk premium associated with the investments.

The findings of this study indicate a positive relationship between stock prices and expected inflation in line with the Fisher (1930) hypothesis, which states that nominal asset returns move one-for-one with the expected inflation so that real stock returns are determined by real factors independently of the rate of inflation. Fisher (1930) argued that asset values should be positively related with the expected inflation, providing a hedge against rising prices. If the implied positive relationship between stock prices and the inflation does not hold, stock investors will be vulnerable to inflation. These findings are contrary with recent research findings such as Litner (1975), Fama and Schwert (1977), Fama (1981, 1982), Geske and Roll (1983) who find evidence that stock returns are negatively affected by both expected and unexpected inflation in the U.S.

The 'proxy Hypothesis "suggested by Fama(1981) claims that the negative stock return inflation relation is spurious. The anomalous stock return-inflation relation is in fact induced by a negative relation between inflation and real activity. Fama's hypothesis predicts that rising inflation rates reduce real economic activity and demand for money. Geske and Roll(1983) proposes a "reverse causality" explanation and argue that a reduction in real activity leads to an increase in fiscal deficits. Since the Federal Reseve Bank monetizes a portion of fiscal deficits, the money supply increases, which in turn increases inflation.

The one period error term is negative and statistically significant at 5%. Its coefficient which is -0.005912 implies that there are economic forces in the economy which operate to restore the long run equilibrium path of the demand following short run disturbances.

CHAPTER FIVE
SUMMARY AND CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

5.1 Summary and conclusion

The objective of this study was to establish the relationship between inflation rates and the stock price movements using time series data covering the period 1999 to 2010. It aimed at finding the relationship between the share prices as proxied by NSE 20 and selected variables which included the CPI Index, the Inflation rate and the expected inflation rate. The estimation procedure takes into account the latest developments in time series modeling.

The results of the analysis revealed that all the variables are integrated of order 1(1). The ECM was found stationary in levels after differencing on order I confirming cointegration, by Engle and Granger formulation. It was therefore possible to estimate a dynamic NSE 20 share index using an error correction model (ECM), because it is the most efficient model for dynamic estimation or equation. The diagnostic tests revealed that the residuals are normally distributed, there is no autocorrelation, there is homoskedasticity and the model is well specified supported by the Cusum test. It is also validated by a negative and significant error correction term coefficient.

The study revealed that all the variables studied, both the CPI and the expected inflation had the expected signs. In addition, the inflation was found to have insignificant impact on the stock price movement at the NSE.

5.2 Recommendations

The foregoing research findings demonstrate that what people anticipate or expect as the overall trend in the inflation rate has an impact on their investment behavior patterns which consequently affect the overall price movements at the NSE as it affects their overall level of disposable incomes. If investors expect that the over inflation will rise, most will also anticipate that the real returns on their investments will be eroded and will therefore demand for higher prices to compensate for this. They may also prefer to invest

in other alternative investments such as the government treasury papers which will offer an inflation premium further depressing the overall stock prices in their 'flight to safety' investment strategy.

The government should therefore put various measures in place to help contain the inflationary expectations in the economy. It should therefore be very careful when applying both the monetary and the fiscal policies to avoid building inflationary expectations which end up hurting the investors as the overall stock prices react to them. Inflation can either be cost driven or demand driven which would also require the government to be careful in formulating policies to check the inflation rates as the wrong reaction may affect the overall expectations. Given that there is a lag from the moment the government formulates policies to the time the benefits are actually felt, the government should be very keen so as not to send out the wrong signals which directly impact the inflationary expectations.

Investors should also be well educated about the stick market so as to be able to understand how the prices react to the overall inflation. This will see to it that they do not blame the company management for being solely responsible for the performance of the share prices, as these are affected by many other factors and both the CPI and the expected inflation are one of them.

5.3 Limitations of the study

In any typical research work, there are always limitations that are experienced. Among them is that the data used was mostly secondary data which was also collected from different data sources that give data depending on different base years. This is a problem as there is need to standardize the data into one base year to avoid overestimation or underestimation of the variables.

The problem of no standardization measures of the variables was also experienced. For example, the study used NSE 20 share index while the NASI share index could have been used instead and may have resulted in different results. The only problem with the NASI

is that it was started in the year 2008. The CPI basket was also rebased and the constituents amended as at February 2009. Despite the fact that the CPI basket was rebased, the introduction of new items by the Kenya National Bureau of Statistics (KNBS) could have meant that the results could have been different if the older items were used.

The research investigated the relationship of only three variables with the stock market index. However, many other factors could have been included These variables may be important in determining the share price movements at the NSE and therefore future studies should assign some of these variables in their studies. Also the NSE 20 share index used, which is made up of only 20 listed companies as representative of the entire listed companies at the NSE are too few. The data collected may not capture events taking place in the broader economy; nevertheless, it was used as a representative of the entire market. The NSE 20 share index is also a price weighted index which is affected by various companies' corporate actions and is also reconstituted once in a while hence there is the risk of survivorship bias. Therefore, the weakness of this study should form a basis for future research in the areas for the author and other researchers.

APPENDICES

Appendix 1: Data used in the study

Year	Month	NSE 20 share index (RHS)	Overall CPI Index	Inflation	Expected Inflation
1999	Jan	2983	42.85	-0.4%	0
	Feb	2989	43.41	1.5%	-0.4%
	Mar	2815	43.95	3.0%	1.5%
	Apr	2768	44.20	3.8%	3.0%
	May	2760	45.11	5.8%	3.8%
	Jun	2756	45.53	5.0%	5.8%
	Jul	2745	45.93	5.2%	5.0%
	Aug	2494	46.43	6.6%	5.2%
	Sep	2428	46.60	8.4%	6.6%
	Oct	2309	46.57	9.4%	8.4%
	Nov	2294	46.83	10.7%	9.4%
	Dec	2303	46.99	10.5%	10.7%
2000	Jan	2301	46.98	9.6%	10.5%
	Feb	2278	46.67	7.5%	9.6%
	Mar	2233	46.54	5.9%	7.5%
	Apr	2162	47.38	7.2%	5.9%
	May	2053	48.99	8.6%	7.2%
	Jun	2003	50.63	11.2%	8.6%
	Jul	1967	51.20	11.5%	11.2%
	Aug	1959	51.68	11.3%	11.5%
	Sep	2001	52.00	11.6%	11.3%
	Oct	2043	51.82	11.3%	11.6%
	Nov	1930	52.28	11.6%	11.3%
	Dec	1913	52.52	11.8%	11.6%
2001	Jan	1897	52.60	12.0%	11.8%
	Feb	1933	51.42	10.2%	12.0%
	Mar	1831	50.95	9.5%	10.2%
	Apr	1768	51.70	9.1%	9.5%
	May	1636	52.39	6.9%	9.1%
	Jun	1657	52.96	4.6%	6.9%
	Jul	1621	53.38	4.3%	4.6%
	Aug	1506	53.77	4.0%	4.3%
	Sep	1401	53.60	3.1%	4.0%
	Oct	1473	53.48	3.2%	3.1%
	Nov	1420	53.40	2.1%	3.2%
	Dec	1355	53.37	1.6%	2.1%
2002	Jan	1343	52.85	0.5%	1.6%
	Feb	1314	52.03	1.2%	0.5%
	Mar	1183	51.98	2.0%	1.2%
	Apr	1129	52.14	0.9%	2.0%

		May	1071	53.28	1.7%	0.9%
		Jun	1087	54.47	2.8%	1.7%
		Jul	1098	54.51	2.1%	2.8%
		Aug.	1043	54.74	1.8%	2.1%
		Sept.	1043	54.55	1.8%	1.8%
		Oct.	1116	54.50	1.9%	1.8%
		Nov.	1162	54.77	2.6%	1.9%
		Dec.	1363	55.63	4.2%	2.6%
2003		Jan	1511	56.21	6.4%	4.2%
		Feb	1558	55.91	7.4%	6.4%
		Mar	1608	57.24	10.1%	7.4%
		Apr	1847	58.21	11.6%	10.1%
		May	2075	61.23	14.9%	11.6%
		Jun	1935	61.96	13.7%	14.9%
		Jul	2005	60.46	10.9%	13.7%
		Aug	2107	59.27	8.3%	10.9%
		Sept.	2380	58.85	7.9%	8.3%
		Oct.	2457	59.44	9.1%	7.9%
		Nov.	2737	59.69	9.0%	9.1%
		Dec.	2738	60.28	8.3%	9.0%
2004		Jan	3158	61.35	9.1%	8.3%
		Feb	3175	61.41	9.9%	9.1%
		Mar	2771	62.00	8.3%	9.9%
		Apr	2708	62.61	7.6%	8.3%
		May	2689	64.08	4.7%	7.6%
		Jun	2640	65.64	5.9%	4.7%
		Jul	2708	65.62	8.5%	5.9%
		Aug	2709	68.63	15.8%	8.5%
		Sept.	2671	70.02	19.0%	15.8%
		Oct.	2830	70.32	18.3%	19.0%
		Nov.	2918	70.07	17.4%	18.3%
		Dec.	2946	70.57	17.1%	17.4%
	2005	Jan	3094	70.48	14.9%	17.1%
		Feb	3213	69.97	13.9%	14.9%
		Mar	3209	70.78	14.1%	13.9%
		Apr	3228	72.64	16.0%	14.1%
		May	3505	73.54	14.8%	16.0%
		Jun	3972	73.46	11.9%	14.8%
		Jul	3982	73.34	11.8%	11.9%
		Aug	3939	73.35	6.9%	11.8%
		Sept.	3833	73.00	4.3%	6.9%
		Oct.	3939	72.93	3.7%	4.3%
		Nov.	3974	73.33	4.6%	3.7%
		Dec.	3973	74.04	4.9%	4.6%
2006		Jan	4172	76.22	8.1%	4.9%
		Feb	4057	76.19	8.9%	8.1%

	Mar	4102	76.62	8.3%	8.9%
	Apr	4025	76.23	4.9%	8.3%
	May	4350	76.48	4.0%	4.9%
	Jun	4260	76.44	4.1%	4.0%
	Jul	4259	76.30	4.0%	4.1%
	Aug.	4486	76.87	4.8%	4.0%
	Sept.	4880	77.23	5.8%	4.8%
	Oct.	5314	77.54	6.3%	5.8%
	Nov.	5615	77.82	6.1%	6.3%
	Dec.	5646	79.46	7.3%	6.1%
2007	Jan	5774	79.75	4.6%	7.3%
	Feb	5774	78.57	3.1%	4.6%
	Mar	5134	78.40	2.3%	3.1%
	Apr	5148	77.76	2.0%	2.3%
	May	5002	78.08	2.1%	2.0%
	Jun	5147	79.53	4.0%	2.1%
	Jul	5340	80.41	5.4%	4.0%
	Aug.	5372	80.86	5.2%	5.4%
	Sept.	5146	81.43	5.4%	5.2%
	Oct.	4971	81.66	5.3%	5.4%
	Nov.	5235	82.47	6.0%	5.3%
	Dec.	5445	83.91	5.6%	6.0%
2008	Jan	4713	87.17	9.3%	5.6%
	Feb	5072	86.88	10.6%	9.3%
	Mar	4843	87.62	11.8%	10.6%
	Apr	5336	90.16	15.9%	11.8%
	May	5176	92.60	18.6%	15.9%
	Jun	5186	93.70	17.8%	18.6%
	Jul	4931	94.11	17.0%	17.8%
	Aug.	4649	95.67	18.3%	17.0%
	Sept.	4180	96.61	18.6%	18.3%
	Oct.	3386.65	96.86	18.6%	18.6%
	Nov.	3341.47	98.59	19.5%	18.6%
	Dec.	3521.18	98.84	17.8%	19.5%
2009	Jan	3198.9	97.55	11.9%	17.8%
	Feb	2474.75	100.00	15.1%	11.9%
	Mar	2805.03	100.96	15.2%	15.1%
	Apr	2800.1	101.84	12.9%	15.2%
	May	2852.57	101.84	10.0%	12.9%
	Jun	3294.56	102.05	8.9%	10.0%
	Jul	3273.75	102.33	8.7%	8.9%
	Aug.	3102.68	102.94	7.6%	8.7%
	Sept.	3005.41	103.42	7.1%	7.6%
	Oct.	3083.63	103.68	7.0%	7.1%
	Nov.	3189.55	103.87	5.4%	7.0%
	Dec.	3247.44	104.66	5.9%	5.4%

2010	Jan	3565.28	104.89	7.5%	5.9%
	Feb	3629.41	105.18	5.2%	7.5%
	Mar	4072.93	104.97	4.0%	5.2%
	Apr	4233.24	105.56	3.7%	4.0%
	May	4241.81	105.79	3.9%	3.7%
	Jun	4339.28	105.61	3.5%	3.9%
	Jul	4438.58	105.98	3.6%	3.5%
	Aug.	4454.59	106.25	3.2%	3.6%
	Sept.	4629.8	106.74	3.2%	3.2%
	Oct.	4659.56	106.97	3.2%	3.2%
	Nov.	4395.17	107.86	3.8%	3.2%
	Dec.	4432.6	109.38	4.5%	3.8%

Appendix 2: Breusch-Godfrey Serial Correlation LM Test:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.151378	Probability	0.120266
Obs*R-squared	4.385475	Probability	0.111611

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 11/03/11 Time: 10:56

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.61200	45.65344	0.407680	0.6841
D(CPI)	0.039991	29.48028	0.001357	0.9989
D(INFLATION)	1.022989	14.10151	0.072545	0.9423
D(EXPECTED)	0.223095	10.92808	0.020415	0.9837
ECM(-1)	-0.006103	0.013969	-0.436913	0.6629
RESID(-1)	0.146846	0.086450	1.698612	0.0917
RESID(-2)	0.083338	0.087429	0.953215	0.3422
R-squared	0.030668	Mean dependent var		-5.47E-15
Adjusted R-squared	-0.012097	S.D. dependent var		205.3140
S.E. of regression	206.5521	Akaike info criterion		13.54669
Sum squared resid	5802273.	Schwarz criterion		13.69173
Log likelihood	-961.5887	F-statistic		0.717126
Durbin-Watson stat	2.002693	Prob(F-statistic)		0.636428

Appendix 3: White Heteroskedasticity Test (No Cross Terms)

White Heteroskedasticity Test:

F-statistic	3.398413	Probability	0.001385
Obs*R-squared	24.11967	Probability	0.002188

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date; 11/03/11 Time: 11:11
Sample: 1999:02 2010:12
Included observations: 143

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-25171.92	43063.57	-0.584529	0.5598
D(CPI)	-1247.062	16058.32	-0.077658	0.9382
(D(CPI))^2	13390.01	8444.020	1.585739	0.1152
D(INFLATION)	868.5942	5923.893	0.146626	0.8836
(D(INFLATION))^2	-804.3227	1562.650	-0.514717	0.6076
D(EXPECTED)	-7519.804	4626.931	-1.625225	0.1065
(D(EXPECTED))^2	1138.450	1177.095	0.967170	0.3352
ECM(-1)	17.53450	30.18036	0.580990	0.5622
ECM(-1)^2	0.000150	0.004582	0.032792	0.9739

R-squared	0.168669	Mean dependent var	41859.06
Adjusted R-squared	0.119037	S.D. dependent var	88920.82
S.E. of regression	83460.74	Akaike info criterion	25.56301
Sum squared resid	9.33E+11	Schwarz criterion	25.74948
Log likelihood	-1818.755	F-statistic	3.398413
Durbin-Watson stat	1.948775	Prob(F-statistic)	0.001385

Appendix 4: Ramsey Reset Test

Ramsey RESET Test:

F-statistic	9.055691	Probability	0.000203
Log likelihood ratio	17.87796	Probability	0.000131

Test Equation:
Dependent Variable: D(NSE)
Method: Least Squares
Date: 11/03/11 Time: 11:16
Sample: 1999:02 2010:12
Included observations: 143

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	30.51164	48.58022	0.628067	0.5310
D(CPI)	12.62389	33.60793	0.375622	0.7078
D(INFLATION)	9.050529	13.85018	0.653459	0.5146
D(EXPECTED)	-14.71215	15.05171	-0.977441	0.3301
ECM(-1)	-0.005000	0.013129	-0.380870	0.7039
FITTED^2	-0.009058	0.007282	-1.243862	0.2157
FITTED^3	0.000212	7.55E-05	2.808474	0.0057

R-squared	0.145658	Mean dependent var	10.13706
Adjusted R-squared	0.107966	S.D. dependent var	208.6674
S.E. of regression	197.0813	Akaike info criterion	13.45282
Sum squared resid	5282380.	Schwarz criterion	13.59786
Log likelihood	-954.8768	F-statistic	3.864464
Durbin-Watson stat	1.613235	Prob(F-statistic)	0.001361

Appendix 6: NSE 20 Share Index Constituents

Agricultural sector
Rea Vipingo plantations Ltd
Sasini Ltd

Automobiles & accessories sector
CMC Holdings Ltd

Banking sector
Barclays Bank of Kenya Ltd
Equity Bank Ltd
Kenya Commercial Bank Ltd
Standard Chartered Bank Kenya Ltd

Commercial and services sector
Express Kenya Ltd
Kenya Airways Ltd
Nation Media Group Ltd

Construction & allied sector
Athi River Mining
Bamburi Cement Ltd
E.A. Cables Ltd

Energy & petroleum sector
Kengen Co. Ltd.
Kenya Power & Lighting Co Ltd

Investment sector
Centum Investment Co Ltd

Manufacturing & allied sector
British American Tobacco Kenya Ltd
East African Breweries Ltd
Mumias Sugar co. Ltd

Telecommunication & technology
Safaricom Ltd

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